

Progress in Ecosystem Services Research

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ABSTRACT

The definition of ecosystem services has evolved and developed as the purpose and target audience of research has changed. The earliest analogue of 'ecosystem services', the concept of 'environmental service functions', appeared in the 1970 SCEP report published by the Massachusetts Institute of Technology (MIT). The concept of "ecosystem services" was formally introduced by Ehrlich in 1981, when Daily proposed that ecosystem services are "the conditions and processes through which natural ecosystems and their constituent species satisfy and sustain human life activities", which was the first definition of ecosystem services. Daily proposed that ecosystem services are "natural ecosystems and their constituent species that satisfy and sustain human life activities through ecosystem conditions and processes", which was the first time the concept of "ecosystem services" was defined, and further elaborated on the difference between ecosystem service products and ecosystem goods. However, Costanza added ecosystem products to the definition of ecosystem services, and Daily and Costanza launched studies on the valuation of ecosystem services, which accelerated the progress of ecosystem services research. At the beginning of the 21st century, the MA report defined the concept of "ecosystem services" as "the benefits that humans derive from ecosystems", which was recognised by the majority of the population and widely used, and it is also the most widely accepted definition up to the present time, which has ushered in the development of research on ecosystem services. This definition was recognised and widely used by most people, and is the most widely accepted definition to date, leading to a boom in research on ecosystem services.

KEYWORDS

Ecosystem; Services; Research.

1. INTRODUCTION

The MA report published in 2005 classified the types of ecosystem services into four categories, mainly including supporting services, provisioning services, regulating services and cultural services. Supporting services mainly include support for maintaining the functions of other service types, such as biodiversity maintenance, soil formation, nutrient cycling and pollination, etc. Provisioning services generally refer to various products and biomass that ecosystems directly provide for human

beings, including timber, medicinal herbs, food and water resources, etc.; regulating services mainly refer to the regulation or improvement of the environment by ecosystems, such as water retention, soil conservation, air purification and climate regulation, etc.; cultural services mainly refer to the noncritical services provided by various types of ecosystems, such as water conservation, air purification and climate regulation, The MA classification system provides a better understanding of ecosystem services and their contribution to human well-being, and is now widely accepted and used by the academic community[1].

The emergence of ecosystem service concepts, types and assessment methods has provided an important theoretical basis and entry point for the study of regional ecosystems and their relationship with nature. In order to cope with global climate change and ecological crises, and to enhance the well-being of the population, the study of ecosystem services has begun to shift from the initial classification and value accounting to the spatial and temporal response related to landscape patterns, the synergy of trade-offs of services, and the coupling relationship with social and economic systems, and has begun to pay more attention to how the results of the study can be applied to the planning of ecological protection and restoration in territorial space, the mechanism of realising the value of ecological products, and management decision-making [106]. The research results have been applied to the planning of ecological protection and restoration, the mechanism of realising the value of ecological products, and the management decision-making, etc[2].

2. PROGRESS IN RESEARCH ON ECOSYSTEM SERVICES

Based on the results of the "ecosystem services" hotspot word mapping (Figures 1-3) and the results of related literature, it can be concluded that the progress of domestic research on ecosystem services can be divided into the following three stages: the first stage (the initial development stage), the second stage (the rapid development stage), and the third stage (the comprehensive development stage). The first stage (initial development), the second stage (rapid development) and the third stage (comprehensive development).

2.1. Phase I

In the first stage, mainly focusing on the late 1990s, this period belongs to the initial development stage of ecosystem research in China. In this stage, some domestic scholars, such as Ouyang Zhiyuan and Xie Gao Di, mainly introduced the main research results of ecosystem services in foreign countries, and highlighted the relevant concepts and classifications based on different disciplinary perspectives. Among them, Xie Gaodi et al. combined the ecosystem service assessment system established by Costanza and classified the main types of ecosystem services into nine types. Li et al. suggested that more attention should be paid to the theoretical research on ecosystem service functions, assessment methods and their standardisation in China. In addition, the Sustainable Development Strategy Group of the Chinese Academy of Sciences believes that ecosystem services include not only material and energy with potential, but also various types of services such as accepting and transforming wastes as well as directly providing, for example, purifying air and water quality[3].

2.2. Phase II

The second phase is the rapid development phase (late 1990s-2010). The keywords "Millennium Ecosystem Assessment (MA)", "ecosystem service value", "valuation", "ecosystem management" and "land use/land cover change (LUCC)" were the most frequently used in this phase. The keywords "Millennium Ecosystem Assessment (MA)", "value of ecosystem services", "valuation", "ecosystem management", "land use/land cover change (LUCC)" and "land use/land cover change (LUCC)" are the most frequent keywords appearing in this stage, with "value" appearing the most frequently, which

suggests that the research of the valuation of ecosystem The term "value" appears most frequently, indicating that this stage focuses more on the assessment of the economic value of ecosystems, which is related to the release of the Millennium Ecosystem Assessment (MA) in this stage. In the early stage, the assessment system, assessment methods and accounting parameters of foreign countries were mainly used to assess the typical natural ecosystems such as forests, wetlands and grasslands in China. As the assessment methods were mainly based on foreign research results, they did not take into account or ignored the special characteristics of China's national conditions, which led to a large discrepancy between the final assessment results and the actual situation. Based on this, Xie Gao Di et al. initially established an assessment index system in line with China's actual status quo based on foreign research results and combined with the actual situation in China, which has been widely promoted and applied. With the gradual advancement of theoretical research and practice, the shortcomings of this assessment system have gradually appeared, such as the heterogeneity of ecosystems, etc. However, with the development of GIS technology, these problems have been gradually and smoothly solved[4].

2.3. Phase III

The third stage (2011-2022) is a period of comprehensive ecosystem research in China. The structure of a large number of ecosystems in China has been continuously damaged and functionally degraded over the past decade or so, posing an important threat to the survival and development of human beings and seriously hindering sustainable socio-economic growth. Landscape architecture, as a discipline with the mission of coordinating the relationship between human and nature, has also seen many scholars begin to focus on the study of ecosystem services from the perspective of the discipline of landscape architecture. The InVEST model developed by Stanford University and other institutions in the United States has been applied and practiced globally as well as in China, and has been widely recognised by scholars, which has also strongly boosted the research process of ecosystem services in China at this stage. For example, based on the InVEST model, Yang Jun et al. comprehensively assessed the four ecosystem services of Dongting Lake Eco-Economic Zone and analysed the trade-offs and synergistic relationships among the services, and the results showed that there is a trade-off between water conservation and habitat quality in the Dongting Lake Eco-Economic Zone, while there is a compatibility relationship between water conservation and soil conservation, and synergistic relationships exist among the other ecosystem services. synergistic relationship among all other ecosystem services. Li Fangzheng et al. used the runoff coefficient formula and the MaxEnt model to simulate and assess the functions of several ecosystem services such as soil and water conservation, carbon sequestration and oxygen release, climate regulation, and biodiversity protection in the shallow mountainous areas of Beijing, and the research results are of great significance in promoting the ecological priority strategy of the region and achieving a sustainable green development mode in the region. Shao et al. identified the main ecosystem services of green space in the Chengdu-Chongqing urban agglomeration based on multiple data sources using the INVEST model and the equations of water balance and soil loss, which provides an important scientific basis for the sustainable development planning in the region[5-7].

3. CONCLUSION

In summary, the research on ecosystem services in China started late, different researchers are in different fields, their research directions and perspectives vary greatly, and their research methods are different, and the theoretical research results and case practice results obtained provide an important basis for the implementation of rural revitalization, ecological civilization construction, and ecological compensation policy development in China. Especially since the 19th Congress of the Communist Party of China was held in 2017, the reform of China's ecological civilization system has been deepening, and the research on ecosystem services based on the perspective of ecological

civilization and the research on ecological civilization construction based on ecosystem services have once again attracted a high degree of attention in the academic community, and the average number of ecosystem services research-related literature published annually has exceeded 1,000 articles. Ecosystem service research has not only become an important theoretical basis for promoting the transformation of the two mountains, helping urban renewal and rural revitalization, but also plays an important role in supporting the management of urban and rural ecosystems as well as the theory and practice of territorial spatial planning system, and the research results have provided a comprehensive framework of social, economic and ecological benefits for scientific decision-making and the harmonious coexistence of human beings and nature. However, objectively speaking, there is still a big gap between China's ecosystem service research and the international level, and most of the research is still based on tracking research, while there is still a lack of original research results; in addition, the relevant research results are still insufficient to guide the government's decision-making and specific practice.

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